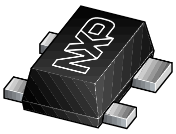

BFU690F

NPN wideband silicon RF transistor

Rev. 2 — 14 March 2014 **Product data sheet**

1. Product profile

1.1 General description

NPN silicon microwave transistor for high speed, low noise applications in a plastic, 4-pin dual-emitter SOT343F package.

1.2 Features and benefits

- Low noise high linearity microwave transistor
- High output third-order intercept point 34 dBm at 1.8 GHz
- 40 GHz f_T silicon technology

1.3 Applications

- Ka band oscillators DRO's
- C-band high output buffer amplifier
- ZigBee
- LTE, cellular, UMTS

1.4 Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CBO}	collector-base voltage	open emitter	-	-	16	V
V_{CEO}	collector-emitter voltage	open base	-	-	5.5	V
V_{EBO}	emitter-base voltage	open collector	-	-	2.5	V
I_C	collector current		-	70	100	mA
P_{tot}	total power dissipation	$T_{sp} \leq 85$ °C [1]	-	-	490	mW
h_{FE}	DC current gain	I_C = 20 mA; V_{CE} = 2 V; T_j = 25 °C	90	135	180	
C_{CBS}	collector-base capacitance	V_{CB} = 2 V; f = 1 MHz	-	404	-	fF
f_T	transition frequency	I_C = 60 mA; V_{CE} = 1 V; f = 2 GHz; T_{amb} = 25 °C	-	18	-	GHz
$G_{p(max)}$	maximum power gain	I_C = 60 mA; V_{CE} = 1 V; f = 1.8 GHz; T_{amb} = 25 °C [2]	-	20.5	-	dB
NF	noise figure	I_C = 15 mA; V_{CE} = 2 V; f = 1.8 GHz; $\Gamma_S = \Gamma_{opt}$	-	0.65	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	I_C = 70 mA; V_{CE} = 4 V; $Z_S = Z_L = 50\ \Omega$; f = 1.8 GHz; T_{amb} = 25 °C	-	22	-	dBm

[1] T_{sp} is the temperature at the solder point of the emitter lead.

[2] $G_{p(max)}$ is the maximum power gain, if K > 1. If K < 1 then $G_{p(max)}$ = Maximum Stable Gain (MSG).

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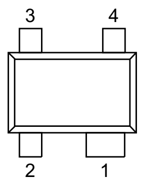
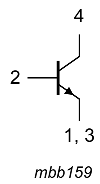
2. Pinning information

Table 2. Discrete pinning

Pin	Description	Simplified outline	Graphic symbol
1	emitter		
2	base		
3	emitter		
4	collector		

3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BFU690F	-	plastic surface-mounted flat pack package; reverse pinning; 4 leads	SOT343F

4. Marking

Table 4. Marking

Type number	Marking	Description
BFU690F	D4*	* = p : made in Hong Kong
		* = t : made in Malaysia
		* = w : made in China

5. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CBO}	collector-base voltage	open emitter	-	16	V
V_{CEO}	collector-emitter voltage	open base	-	5.5	V
V_{EBO}	emitter-base voltage	open collector	-	2.5	V
I_C	collector current		-	100	mA
P_{tot}	total power dissipation	$T_{sp} \leq 85$ °C [1]	-	490	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		-	150	°C

[1] T_{sp} is the temperature at the solder point of the emitter lead.

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6. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-sp)}$	thermal resistance from junction to solder point	[1]	132	K/W

[1] Determined by simulation.

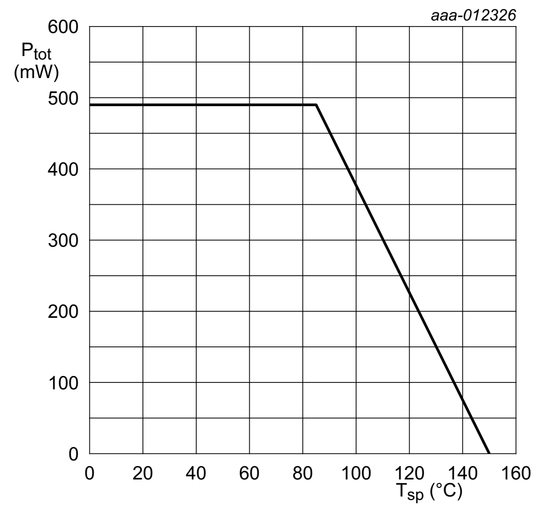

Fig 1. Power derating curve

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7. Characteristics

Table 7. Characteristics

T_j = 25 °C unless otherwise specified

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 2.5 μA; I_E = 0 mA		16	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 1 mA; I_B = 0 mA		5.5	-	-	V
I_C	collector current			-	70	100	mA
I_{CBO}	collector-base cut-off current	I_E = 0 mA; V_{CB} = 8 V		-	-	100	nA
h_{FE}	DC current gain	I_C = 20 mA; V_{CE} = 2 V		90	135	180	
C_{CES}	collector-emitter capacitance	V_{CB} = 2 V; f = 1 MHz		-	527	-	fF
C_{EBS}	emitter-base capacitance	V_{EB} = 0.5 V; f = 1 MHz		-	1699	-	fF
C_{CBS}	collector-base capacitance	V_{CB} = 2 V; f = 1 MHz		-	404	-	fF
f_T	transition frequency	I_C = 60 mA; V_{CE} = 1 V; f = 2 GHz; T_{amb} = 25 °C		-	18	-	GHz
$G_{p(max)}$	maximum power gain	I_C = 60 mA; V_{CE} = 1 V; T_{amb} = 25 °C	[1]				
		f = 1.5 GHz		-	22	-	dB
		f = 1.8 GHz		-	20.5	-	dB
		f = 2.4 GHz		-	17	-	dB
$\|s_{21}\|^2$	insertion power gain	I_C = 60 mA; V_{CE} = 1 V; T_{amb} = 25 °C					
		f = 1.5 GHz		-	15	-	dB
		f = 1.8 GHz		-	13.5	-	dB
		f = 2.4 GHz		-	11	-	dB
NF	noise figure	I_C = 15 mA; V_{CE} = 2 V; $\Gamma_S = \Gamma_{opt}$; T_{amb} = 25 °C					
		f = 1.5 GHz		-	0.60	-	dB
		f = 1.8 GHz		-	0.65	-	dB
		f = 2.4 GHz		-	0.70	-	dB
G_{ass}	associated gain	I_C = 15 mA; V_{CE} = 2 V; $\Gamma_S = \Gamma_{opt}$; T_{amb} = 25 °C					
		f = 1.5 GHz		-	18.5	-	dB
		f = 1.8 GHz		-	17.5	-	dB
		f = 2.4 GHz		-	15.5	-	dB
$P_{L(1dB)}$	output power at 1 dB gain compression	I_C = 70 mA; V_{CE} = 4 V; $Z_S = Z_L$ = 50 Ω; T_{amb} = 25 °C					
		f = 1.5 GHz		-	22	-	dBm
		f = 1.8 GHz		-	22	-	dBm
		f = 2.4 GHz		-	20	-	dBm
IP3	third-order intercept point	I_C = 70 mA; V_{CE} = 4 V; $Z_S = Z_L$ = 50 Ω; T_{amb} = 25 °C					
		f = 1.5 GHz		-	34	-	dBm
		f = 1.8 GHz		-	34	-	dBm
		f = 2.4 GHz		-	33	-	dBm

[1] $G_{p(max)}$ is the maximum power gain, if K > 1. If K < 1 then $G_{p(max)}$ = MSG.

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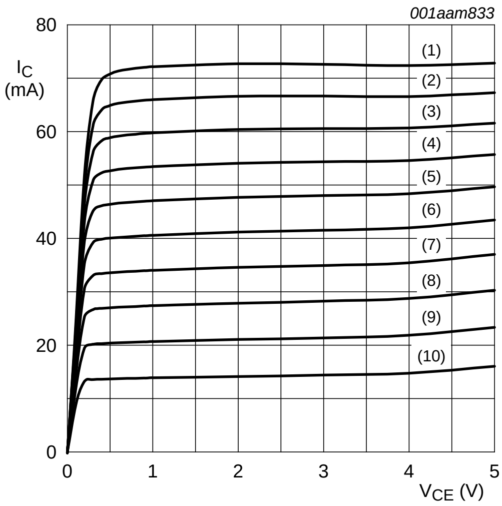


T_{amb} = 25 °C.

(1) I_B = 550 μA

(2) I_B = 500 μA

(3) I_B = 450 μA

(4) I_B = 400 μA

(5) I_B = 350 μA

(6) I_B = 300 μA

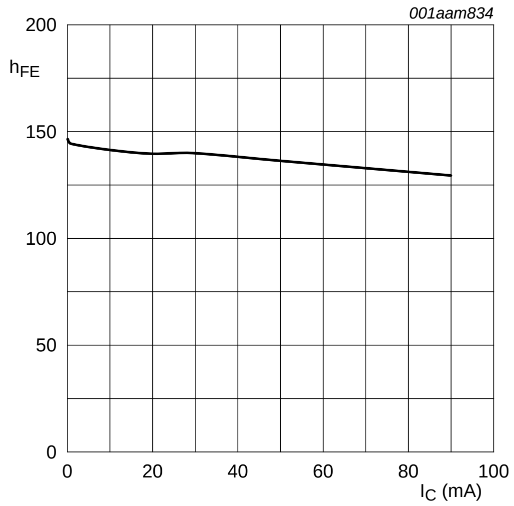
(7) I_B = 250 μA

(8) I_B = 200 μA

(9) I_B = 150 μA

(10) I_B = 100 μA

Fig 2. Collector current as a function of collector-emitter voltage; typical values



V_{CE} = 2 V; T_{amb} = 25 °C.

Fig 3. DC current gain as a function of collector current; typical values

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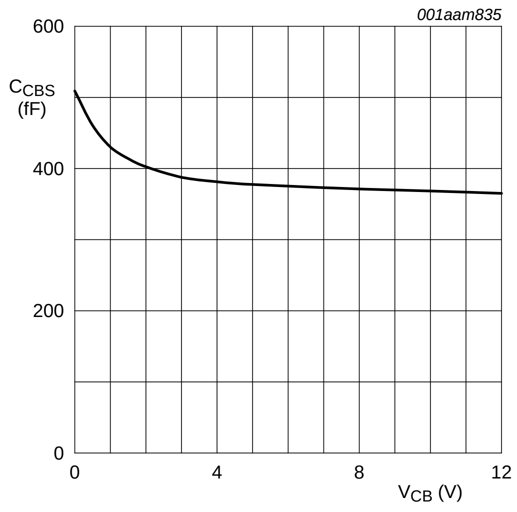
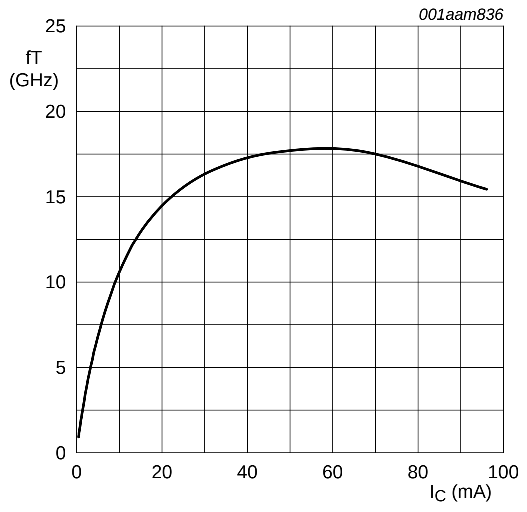


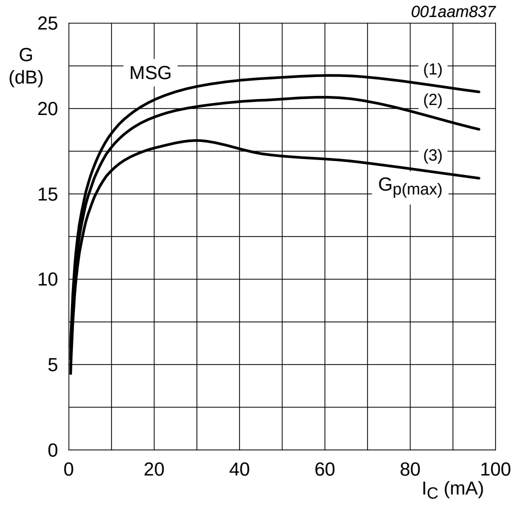
f = 1 MHz, T_{amb} = 25 °C.

Fig 4. Collector-base capacitance as a function of collector-base voltage; typical values



V_{CE} = 1 V; f = 2 GHz; T_{amb} = 25 °C.

Fig 5. Transition frequency as a function of collector current; typical values



V_{CE} = 1 V; T_{amb} = 25 °C.

(1) f = 1.5 GHz

(2) f = 1.8 GHz

(3) f = 2.4 GHz

Fig 6. Gain as a function of collector current; typical value

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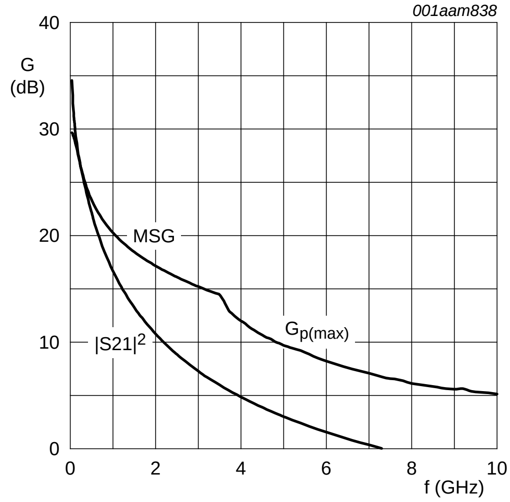
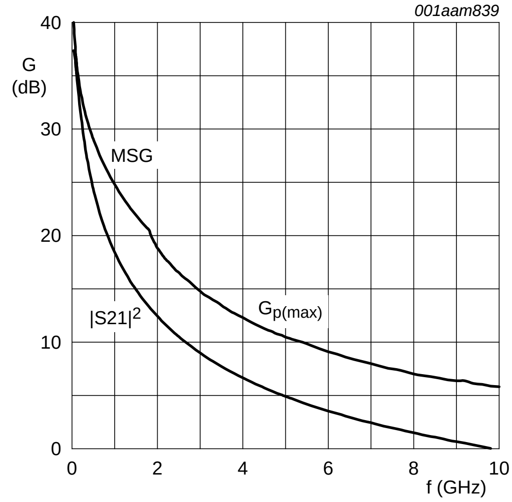


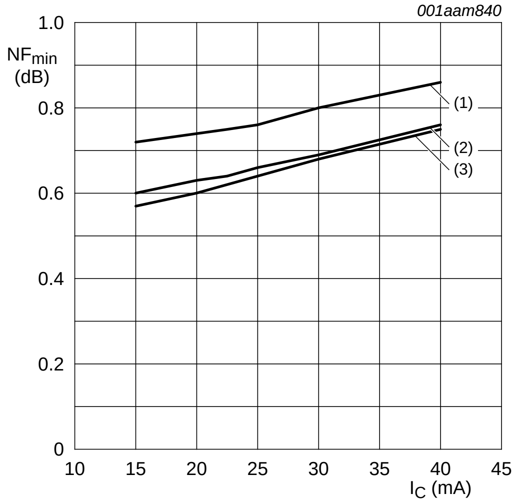
V_{CE} = 1 V; I_C = 10 mA; T_{amb} = 25 °C.

Fig 7. Gain as a function of frequency; typical values



V_{CE} = 1 V; I_C = 60 mA; T_{amb} = 25 °C.

Fig 8. Gain as a function of frequency; typical values



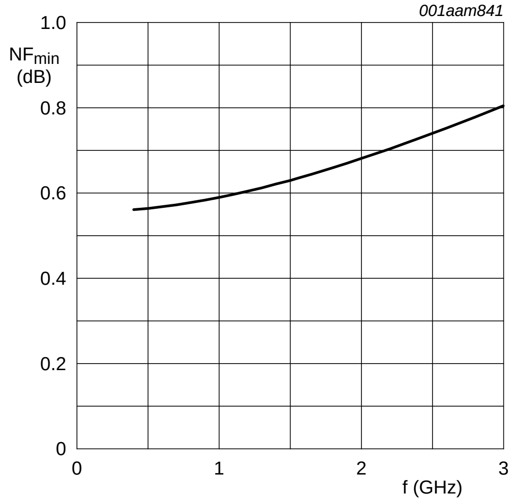
V_{CE} = 2 V; T_{amb} = 25 °C.

(1) f = 2.4 GHz

(2) f = 1.8 GHz

(3) f = 1.5 GHz

Fig 9. Minimum noise figure as a function of collector current; typical values



V_{CE} = 2 V; I_C = 15 mA; T_{amb} = 25 °C.

Fig 10. Minimum noise figure as a function of frequency; typical values

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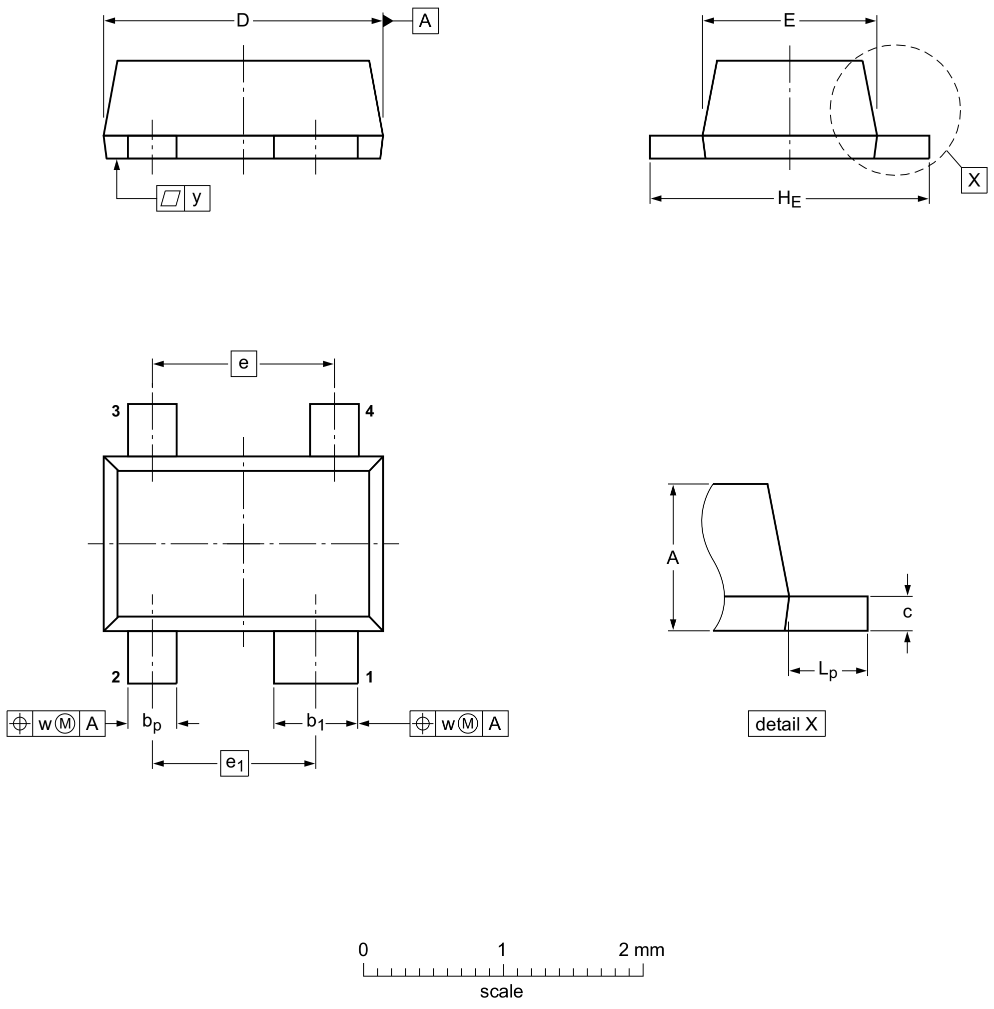
8. Package outline

Plastic surface-mounted flat pack package; reverse pinning; 4 leads **SOT343F**



DIMENSIONS (mm are the original dimensions)

UNIT	A max	b_p	b_1	c	D	E	e	e_1	H_E	L_p	w	y
mm	0.75 0.65	0.4 0.3	0.7 0.5	0.25 0.10	2.2 1.8	1.35 1.15	1.3	1.15	2.2 2.0	0.48 0.38	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT343F						~~05-07-12~~ 06-03-16

Fig 11. Package outline SOT343F

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9. Handling information

CAUTION

This device is sensitive to ElectroStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices.

Such precautions are described in the *ANSI/ESD S20.20*, *IEC/ST 61340-5*, *JESD625-A* or equivalent standards.

10. Abbreviations

Table 8. Abbreviations

Acronym	Description
DRO	Dielectric Resonator Oscillator
Ka	Kurtz above
LTE	Long Term Evolution
NPN	Negative-Positive-Negative
UMTS	Universal Mobile Telecommunications System

11. Revision history

Table 9. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BFU690F v.2	20140314	Product data sheet	-	BFU690F v.1
Modifications:	• Table 1 on page 1: The value and conditions for P_{tot} have been updated. • Table 5 on page 2: The value and conditions for P_{tot} have been updated. • Table 6 on page 3: The value and conditions for $R_{th(j-sp)}$ have been updated. • Figure 1 on page 3: The graph has been updated. • Section 9 on page 9: The ESD caution has been moved here from Section 1.1 on page 1.			
BFU690F v.1	20101216	Product data sheet	-	-

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12.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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